Route Pic-1

FSTO
STO

EIK
CJK
DD
AEW
CLH
MRB
HWS
HLP

XC

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

REPORT

OF

WESTERN PINE BEETLE SURVEY

HAPPY CAMP - LAVA BED AREA

MODOC NATIONAL FOREST

NOVEMBER, 1927

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by

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1927

STANFORD UNIVERSITY, CALIFORNIA
NOVEMBER 4, 1927

GOVERNMENT PRINTING OFFICE

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Frontispiece:-

Airplane view of the north slope of Timber Mt. showing the large groups of pines (white tops) recently killed by the western pine beetle. Taken from an altitude of 2000 feet above the forest. September 28, 1927. (The transparent guide sheet shows the location of the more prominent groups.)

SUMMARY

1. The following report covers the sixth annual pine beetle survey of the Modoc-Lava Bed Area of the Modoc National Forest, California.

2. Since 1921 the percent of stand and volume killed on this area has been as follows:

	Percent of Stand Killed:	Volume B.F.
1921	.92%	45,990,000
1922	.75%	37,381,000
1923	.40%	19,760,000
1924	.71%	35,590,000
1925	1.09%	68,350,000
1926	2.04%	115,200,000
1927	3.26%	183,900,000
Total	9.17	506,171,000

The average loss per year for the last seven years has been about 72,300,000 board feet, representing 1.31% of the stand.

3. The present infestation shows a decided increase over that of last year and in some places has caused a loss in excess of 14% of the stand for the year.

The heaviest and most aggressive losses occurred on the Badger Unit where over ten percent of the stand was killed during 1927.

On other units only moderate increases were recorded, and the peak of infestation appears to have been reached.

4. The subnormal moisture conditions and increased root competition resulting from the recent period of drought are thought to be underlying causes of the beetle epidemic. With normal precipitation and favorable growth conditions the chances are that the epidemic over most of the area will subside.

5. The possible courses of action are:-

(1) To allow the beetles to continue their activities and trust to nature to bring about the final adjustment.

(2) To log the area and salvage the beetle killed timber as well as susceptible green trees.

(3) To inaugurate artificial control.

At the present time the consideration of artificial control appears advisable only on the Badger Unit, and even here the timber values may not be high enough to warrant the cost under present conditions.

Undertaking control on a small block of the more valuable timber promises some relief and is recommended for the consideration of the owners.

PREFACE

During the past few years the heavy losses of western yellow pine (due to pine beetle activity) have caused the owners considerable concern. From the investigative standpoint the Bureau of Entomology has also been interested in a study of the area. As a result, this area has been under observation during the past six years, and the present report covers the sixth annual survey of the area.

This survey was made by a crew of three men, consisting of F.P. Keen, Associate Entomologist, W.J. Buckhorn and M.H. England, Field Assistants, of the Bureau of Entomology, during the period September 1 to October 15, 1927.

The check plots established in former years were again cruised and the recent loss marked, mapped and tabulated. In addition, strip counts were made through various portions of the forest to determine the extent and location of the heavier centers of infestation. This ground work was further supplemented by aerial observations and photographs. Through the courtesy of the U.S. Forest Service, the forest fire patrol plane was detailed for a two-day flight over the area. This not only made possible the securing of some aerial photographs of the infested area, but gave a splendid opportunity to view the country as a whole and size up the relative intensity of the loss in various portions of the area. Captain Boggs, the pilot, gave splendid cooperation in this work.

Through a cooperative agreement the Forest Service paid the field expenses, and the Bureau of Entomology paid the salaries and furnished the field equipment. The Pickering Lumber Company contributed fifty dollars toward the expenses of the survey. The total cost was as follows:

Salaries (Bureau of Entomology) - - - - - - -	$780.00
Expenses: Field work (Forest Service) - - - -	329.44
Gas and oil for airplane (Pickering Lumber Company) - - - - - - -	50.00
Total - - -	$1159.44

HAPPY CAMP - LAVA BED AREA

MODOC NATIONAL FOREST

The description of this area--its soil, ground cover, timber characteristics etc.--was given in considerable detail in the report of last year (October 25, 1926) which was distributed to cooperators. Therefore the present report will deal only with the progress of the infestation in the various units of this area.

Resumé of Past Infestation

This area first came under observation in 1922 and has been examined each year since then. These surveys show that starting with 1921 the infestation declined to an endemic stage in 1923, and then following the dry winter of 1923-24 started to increase, and for each succeeding year practically doubled in volume over that of the previous year. As a result the losses suffered in 1926 and 1927 were tremendous. The loss for 1927 on six sample plots was 16 times as great as that for 1923. This is graphically shown in the accompanying blueprint chart.

Taking the area as a whole, the percent of stand and volume killed each year since 1921 has been as follows:

	Percent of stand killed	Volume B.F.
1921	.92%	45,990,000
1922	.75	37,381,000
1923	.40	19,760,000
1924	.71	35,590,000
1925	1.09	68,350,000
*1926	2.04	115,200,000
*1927	3.26	183,900,000(tentative)

Since the rate of growth is probably somewhere between 1% and 2% of the stand annually, the losses up to and including those of 1925 were offset by growth except in cases where the losses were concentrated on limited areas. Since 1925 the losses greatly exceed the growth rate and represent a real depletion in the timber capital.

*Exclusive of the Big Valley Mt. and Hot Springs Units which, on account of mixed ownership and endemic conditions, were dropped from further consideration.

The Present Infestation

In the survey of last year it was noted that the infestation was starting to merge into large groups, and that the groups of summer-killed trees were larger than those killed in the fall. From this evidence the deduction was made that the infestation had probably reached a peak and was more apt to decline than to make further increases. The conviction that 1927 would see a decline in the infestation was further strengthened when the winter of 1926-27 developed a precipitation above the normal. But these hopes were doomed to disappointment, as the beetles proceeded to kill nearly twice as much timber in 1927 as they had in 1926. The 50-tree groups of 1926 grew to 100-tree groups for 1927, and areas previously showing a comparatively small loss developed infestations exceeding 1000 trees per section. No one had ever supposed that the western pine beetle could produce an epidemic comparable with the Black Hills beetle in Rocky Mountain yellow pine or the mountain pine beetle in lodgepole pine; but the Modoc infestation of 1927 showed that this beetle can cause losses of comparable severity when conditions are favorable for it.

However, the increase of infestation was not uniform over the entire area. The northern and eastern edges of the Glass Mt. Unit, which has been so heavily infested in the last few years, only showed a slight increase, and it appears that this infestation has reached its peak, and is now declining. The reason for this is that nearly half of the stand, including nearly all of the susceptible trees, has been killed already, and there is nothing left for the beetles to attack except younger and thriftier trees, trees growing rapidly enough to offer considerable resistance. No marked increase occurred in the Lava Bed, Happy Camp, White Horse or Pit River Units. But the Badger Unit showed a tremendous increase. Starting with a loss of only 47 trees on the check section in 1923, the infestation increased by leaps and bounds until the 1927 loss will probably exceed 1400 trees. There is nothing to indicate that this infestation has reached its peak, and whether it increases still more in 1928 or declines will depend largely upon general climatic factors and the resistance of the trees.

The attached map shows the present status of the infestation in terms of percent of stand killed.

Conditions by Units

Glass Mountain Unit

This unit, while still vividly red with the dead foliage of the beetle-killed trees, does not look as bad as it did last year. There are fewer trees with newly fading foliage than with old dead needles, and the indications are that the peak of this infestation has been reached. In viewing this unit from the air it was very noticeable that the infestation consisted of scattered trees rather than large groups, and that it was heavily concentrated in the north and northeastern portion of this unit. Pictures taken from the air and from the ground show the scattered character of this infestation.

The check section (T 44 N, R 5 E, Sec. 36), which has been considered regularly since 1921, has shown a percentage of stand killed as follows:

1921 - .89%
1922 - 1.89
1923 - .51
1924 - 1.75
1925 - 3.82
1926 - 5.57
1927 - 5.57 (est.)
Total -20.00%

Thus 20 per cent. of the stand on this seation has been killed by beetles during the past seven years. On sections further north in this unit a much higher percentage of stand has been lost, amounting in some cases to more than 50%.

Timber Mt. Unit

During 1926 the beetles prospered on this unit and killed nearly twice as many trees as they had in 1925, which was more than too many. Several groups of over 100 killed trees in each group developed on the north slope of Timber Mountain. Several airplane views and ground views were secured which show these heavy groups.

A fire which burned over the eastern half of the mountain in July 1924 caused a heavy concentration of beetles in and surrounding the burn. In 1927 these beetles for the most part leftthe burn and scattered in the adjoining stand, causing a heavy loss in the unburned portion of the mountain.

Badger Unit

When the first surveys were made on the Badger Unit it was found to be relatively free from beetle infestation. The survey made in 1923 showed an annual average loss of only from 30 to 60 trees per section. But since 1923 the beetles have each year increased in numbers, until now the infestation on this unit is heavier than on any other portion of the area, and in some places reaches the amazing total of 1700 trees killed per section during the past year, which means the loss of much more than a million board feet per section, or about 2000 board feet per acre.

This infestation occurs in groups, with from 50 to 100 killed trees in each group and with the groups fairly close together. Air observations plainly showed that the heavy infestation was very uniformly distributed over the entire unit.

The check plot of 320 acres at Badger Well is a good example of the way this infestation has increased by leaps and bounds during the past two years:

	Volume Killed	Percent of stand
1921	35,090 b.f.	.97%
1922	26,170 "	.72
1923	17,830 "	.50
1924	25,600 "	.71
1925	46,700 "	1.30
1926	110,040 "	3.06
1927	438,000 "	12.18(tentative)
Total	689,430 "	19.44%

The average loss per year for the past seven years is 308 board feet per acre.

The reason why the infestation increased so much more rapidly on this unit during 1926 and 1927 was probably due in a large measure to the fact that this area has had no severe beetle epidemic for a good many years, although the stand is a highly susceptible one. By this I mean that the area was of poor site quality, running to sites IV and V. Since the beetle losses had been low, no thinning of the stand had occurred, and the trees during the drought years suffered from too much moisture competition with their neighbors. In the second place, with light losses the natural enemies of the beetles were scarce, which allowed the beetles to multiply unhindered after they had once gotten started. This more virulent type of epidemic in virgin areas has been noted a number of times. The beetles always tend to move away from the center of heavy infestation into new fields until an entire area has been swept by them, and then the area may be comparatively free from losses for a few years. Taking this behavior into account, any block of yellow pine on poor sites can be looked upon with suspicion as susceptible to heavy beetle losses unless the stand has been recently thinned by some agency such as logging, fire or beetle attack.

Lava Unit

While this unit has also responded to the general influences and shown an increase in beetle losses for 1927, these losses are still not heavy enough to cause any concern, and probably will not increase any further. This is due to the open spacing of the stand and the corresponding vigorous growth attained by the individual trees.

Happy Camp Unit

The infestation on this unit in 1926 was characterized by its concentration in large groups, with very little scattered infestation among the groups. In driving through the unit, if by chance these large groups were not encountered, one might think that the unit was very clean. But in viewing the unit from the air it was noted that these large groups were pretty evenly distributed throughout the entire unit.

The grouping of infestation first started in 1925, with a more marked concentration into groups in 1926. Contrary to the opinion expressed by some that this signified the approach of a decline, the infestation made a further concentration into groups in 1927, and the groups grew to 100-tree groups where they had been 50-tree groups in the previous year.

Pit River Unit

During 1927 the scattered stands comprising this unit showed only a slight increase in loss over that of 1926. On the north and east slopes of Happy Camp Mountain the infestation is so much lighter than on the Badger or Glass Mt. Unit as to look like none at all. The check section on Turner Creek showed a loss of about 210 trees per section for 1927, which represented a little over 2% of the stand and is somewhat in excess of the probable replacement by growth.

In flying over this unit one patch of heavy infestation was found on an isolated mountain north of West Lake Butte which had not been discovered by the ground survey. The area involved three or four sections which were as heavily infested as the Badger Unit, probably suffering a loss for 1927 of about 1500 trees per section.

White Horse Unit

The 1927 loss on the White Horse Unit increased about 50% over that of 1926, developing a loss which represented about 1.5% of the stand. Such a loss, while normally considered as very heavy, still falls below the probable growth replacement, and hence is not so serious a matter unless it should make farther increases. With the more favorable moisture conditions of the past year this is not very apt to happen, and the owners here are probably safe in trusting to Nature to apply her own remedies.

Big Valley Mt. Unit and Hot Springs Unit

These units lie outside of what is properly the Happy Camp-Lava Bed Area. They represent different site and type conditions. The timber is for the most part divided into numerous small holdings, the owners of which have shown no particular interest in the insect surveys. Since the infestation on these units does not tie in with that on the area proper, they were not covered in this year's survey and will be dropped from future consideration.

Probable Developments in the Future

As pointed out in the report of last year, present evidence indicates that the underlying causes of the barkbeetle epidemic on this area have been mainly (1) severe moisture competition of the trees during the recent period of drought, (2) a high percentage of susceptible trees in the stand, especially those of overmaturity and of slow growth, and (3) favorable conditions for a rapid development of beetle broods.

It was thought that the wet winter of 1926-27 would relieve the situation, especially as to moisture competition, give the trees better growing conditions and thus make them more resistant to beetle attacks. But contrary to expectations, the summer of 1927 was short and cold, and as a result the trees made slightly less growth in 1927 than they did in either 1925 or 1926. The beetles therefore by sheer weight of numbers, and meeting with little tree resistance, again carried on as they had in the past three years, and killed more timber than during any season in the past for which we have records.

What will happen in 1928 cannot be predicted with any degree of certainty. Given another winter of normal precipitation and a favorable growing season in 1928, the chances are that the trees will respond with accelerated growth, and increased resistance, and that the beetles will find themselves hard pressed to maintain their epidemic killings. With subnormal conditions the epidemic will probably continue. In either case considerable loss can be expected in 1928; for now, by weight of numbers alone, they can overcome and kill even the thrifty trees simply by concentrating their attacks upon them.

Recommendations

The three courses of action suggested in the report of last year still apply in a consideration of the problem presented by this infestation. These were:

(1) To allow the beetles to continue their activities and trust to nature to bring about a final adjustment;

(2) To log the area and salvage the recently-beetle-killed timber as well as the green timber that is apt to be killed, and

(3) To inaugurate artificial control work and destroy the infesting beetle broods.

So far, the first course has been the one adopted by the owners, and has resulted this year in a loss of nearly two hundred million board feet of timber, valued at about a million dollars.

To have followed the second course would without doubt have had some effect in reducing losses, but would have involved many difficulties of administration and have left only a small margin of profit, if any.

Artificial control, if it had been undertaken in 1924 and continued each year, would have prevented the tremendous losses of 1926 and 1927 and would have yielded a fairly large margin of profit in saved timber. To do this work now would involve tremendous expense, with a chance for only a small margin of profit.

The only area where control work would now seem advisable is in the Badger Unit, where the aggressive character of the infestation does not promise a rapid subsidence, and where there are still large quantities of overmature, slow-growing trees which offer little resistance to beetle attacks. Here a campaign of artificial control would seem to be badly needed. Even if conditions turn for the better in 1928, a heavy loss will undoubtedly be sustained in this unit before normal conditions can be restored.

To treat the overwintering broods of this year over the entire Badger Unit would cost approximately $250,000, half of which would be chargeable to the Forest Service, 35% to the Pickering Lumber Company and 15% to other owners.

The advisability of undertaking a project of this magnitude would depend first upon whether or not the owners considered that their timber values warranted the staking of so large a sum on protection. The first work would probably have to be followed up for a number of years to prevent another building-up of epidemic conditions on the area, which of course would involve additional expenditures. The difficulties in administration alone would be almost insurmountable in getting a project of this size under way in the spring of 1928. This fact, together with the uncertainty of securing federal appropriations, would probably result in the delay of any control campaign for another year. If the infestation declines, control could then be handled at a reduced cost, although the additional losses for the season of 1928 would have to be sustained.

Possibly the owners would feel justified in undertaking control on a portion of their more valuable timber lands and not over the entire unit, in which case it would be possible to block out certain small areas within the larger unit that which could be worked separately and still secure effective results, while the cost of such work would be materially reduced in proportion to the acreage covered.

TABLE I

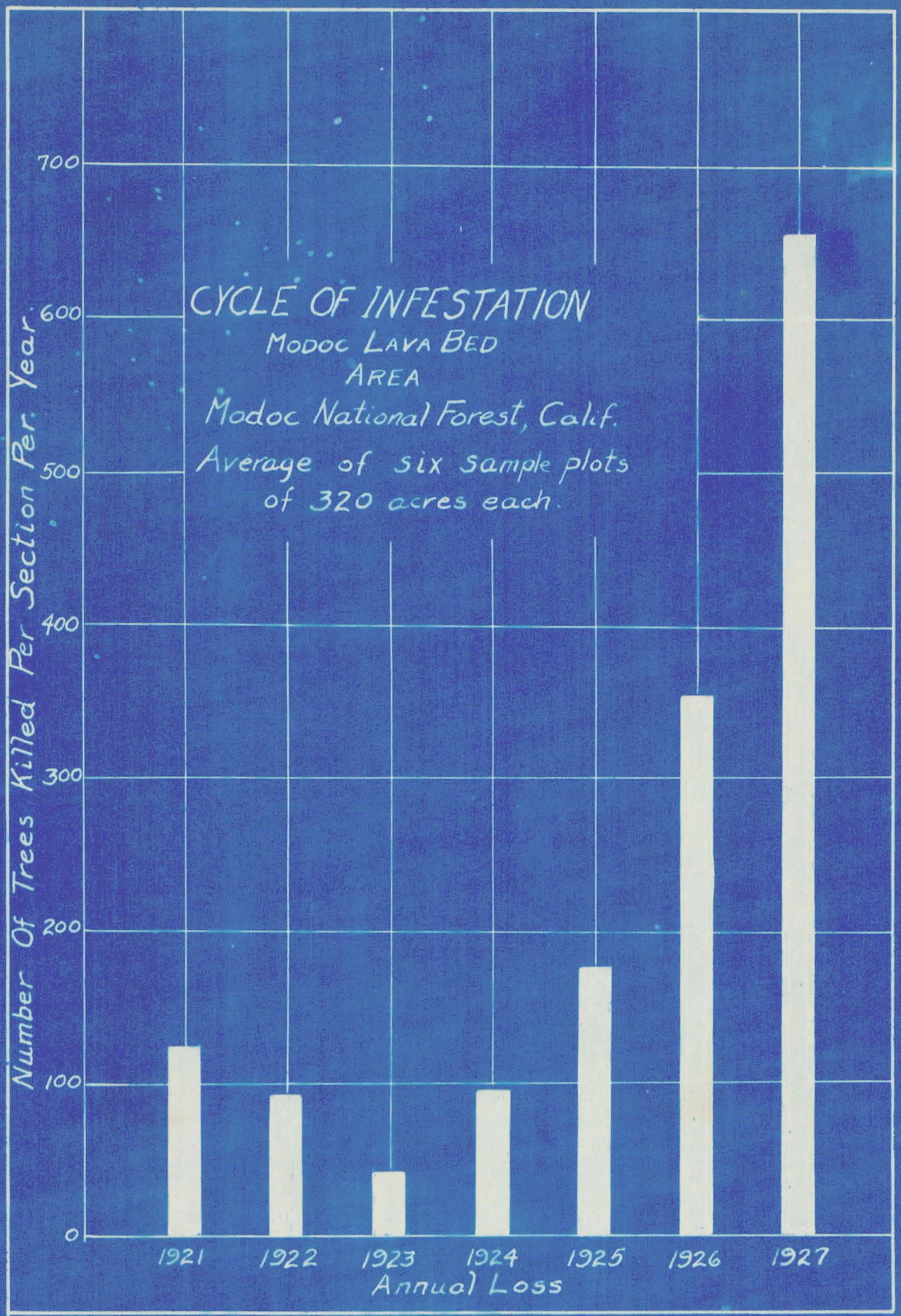
YELLOW PINE BEETLE LOSSES FOR 1926

Unit	Acres	Stand MBM	Killed in 1926		
			Trees	Volume(M.B.M.)	% Stand
1. Glass Mt.	68,860	1,214,300	31,900	20,750	1.71%
2. Timber Mt.	2,600	22,000	2,000	1,900	8.64
3. Badger	67,760	818,460	35,450	28,350	3.47
4. Lava	73,200	631,300	14,800	12,600	2.00
5. Happy Camp	68,660	1,298,840	28,400	28,400	2.19
6. Pit River	35,200	310,140	9,230	7,350	2.38
7. White Horse	60,800	1,337,720	13,220	15,850	1.19
	377,080	5,632,760	135,000	115,200	2.04

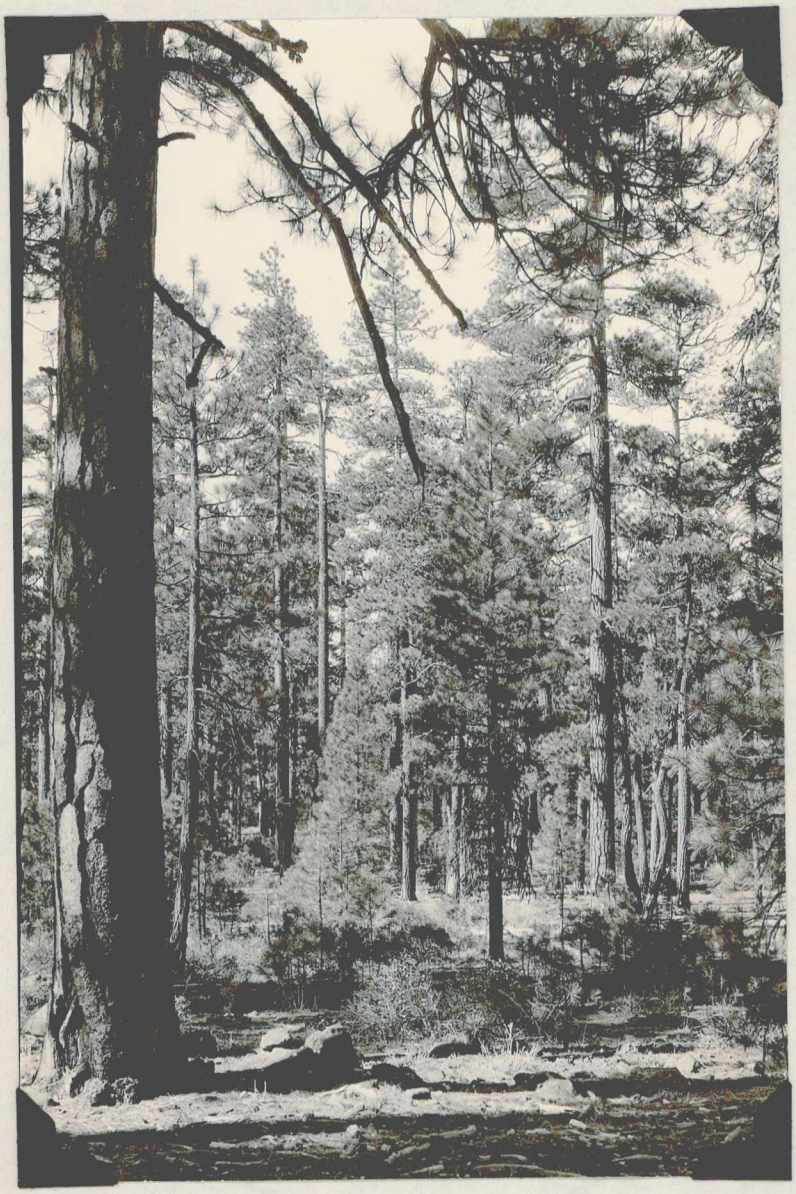
TABLE II

ESTIMATED BEETLE LOSSES FOR 1927

Unit	Trees Killed	Volume Killed (M. B. M.)				Total Volume	% Stand
		Nat. For.	Red River Lbr. Co.	Pickering	Others		
Glass Mt.	40,000	6,700	4,800	10,500	--	22,000	1.81%
Timber Mt.	4,500	2,400	700	--	50	3,150	14.30
Badger	128,000	42,000	6,800	40,000	800	89,600	10.95
Lava	20,000	13,300	700	--	--	14,000	2.22
Happy Camp	35,000	1,900	25,500	350	250	28,000	2.16
Pit River	14,500	4,700	600	4,800	50	10,150	3.28
White Horse	17,000	2,300	14,100	--	600	17,000	1.27
	259,000	73,300	53,200	55,650	1,750	183,900	3.26


CYCLE OF INFESTATION
Modoc Lava Bed
Area
Modoc National Forest, Calif.
Average of six sample plots
of 320 acres each.
Number Of Trees Killed Per Section Per Year
0
100
200
300
400
500
600
700
1921
1922
1923
1924
1925
1926
1927
Annual Loss

F.P. Keen. 1927

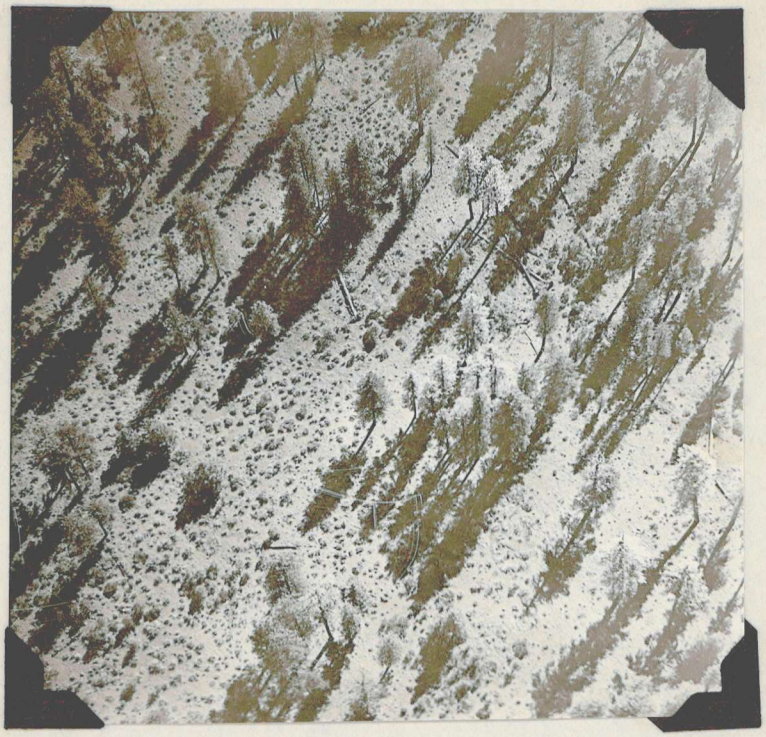


Timber stand of the Happy Camp Unit. The infestation in this unit is concentrated into large groups.

Yellow pine timber on the Lava Bed Unit showing its scattered distribution and the sharp pointed thrifty crowns of a majority of the trees. Very little beetle activity is found in this unit.

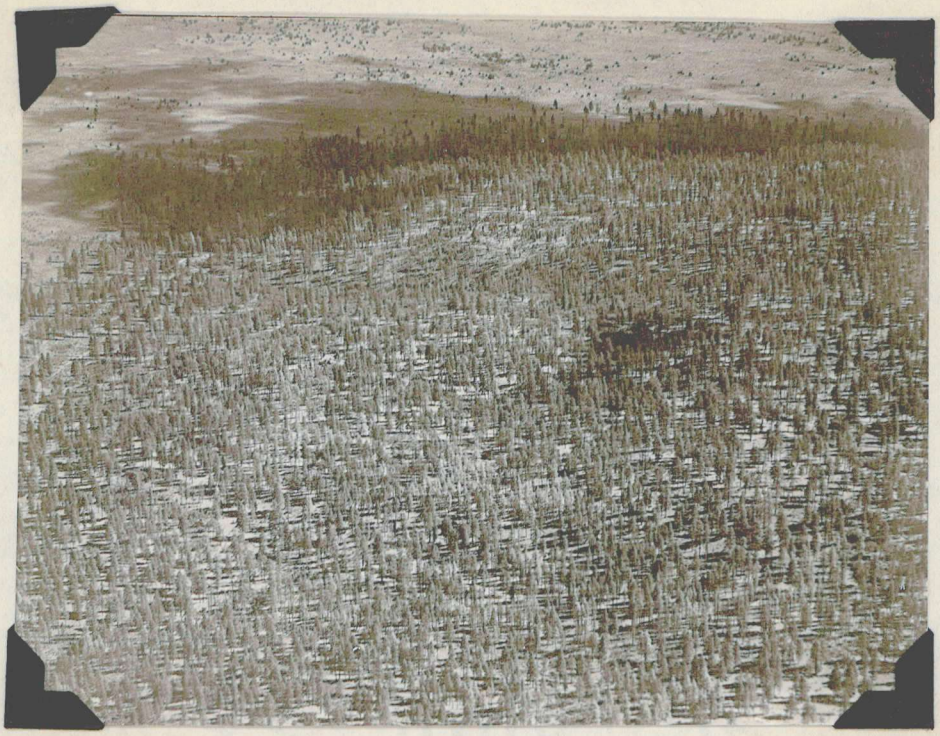
North slope of Timber Mt. showing the groups of recently killed yellow pines (white tops).

Looking southwest towards Glass Mt. from the north edge of this unit. The timber in the foreground is very heavily infested with pine beetles.

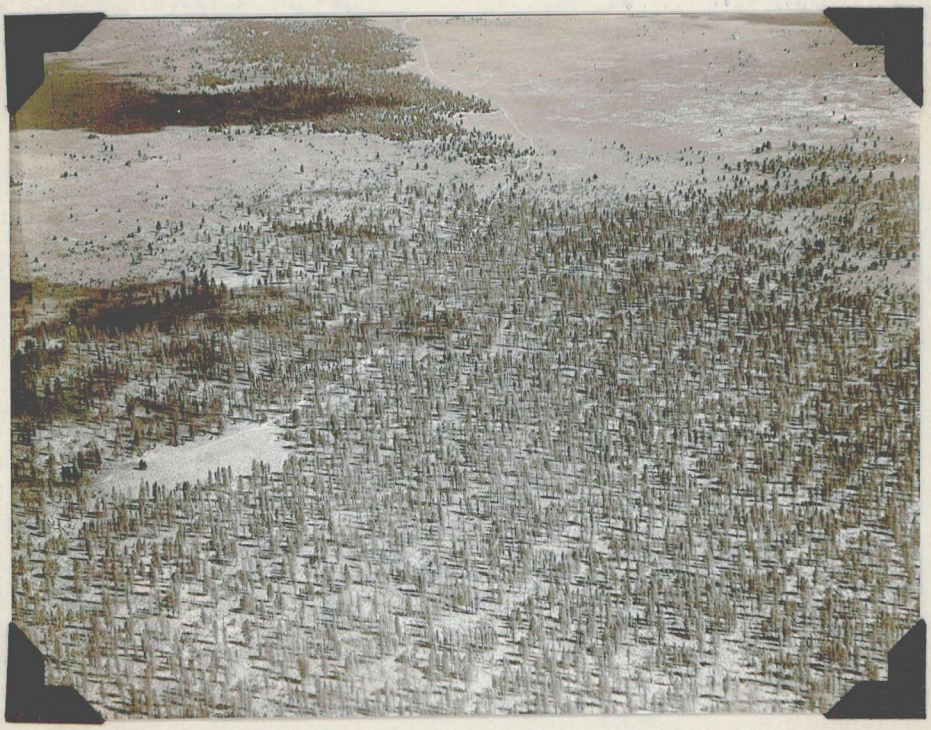


Looking down on the Timber Mt. plot from an altitude of 1500 feet above the forest. Note the group of white top trees which were recently killed by barkbeetles. These yellow trees were brought out in the picture by the use of color filters.

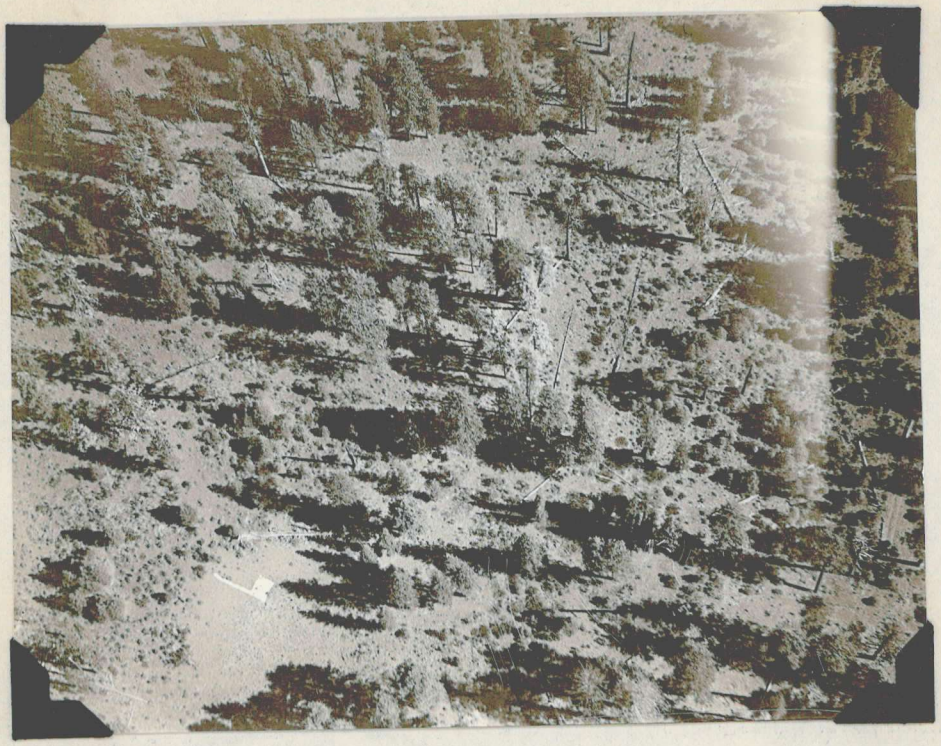
Airplane view of north slope of Timber Mt. taken from an altitude of about 2000 feet above the forest. Dry Lake in the distance. Note the groups of white top pines which are those recently killed by beetles.



Airplane view of north slope of Timber Mt. showing groups of yellow pine killed by western pine beetle (white tops in picture). Taken at an altitude of 2000 feet above forest. September 28, 1927.

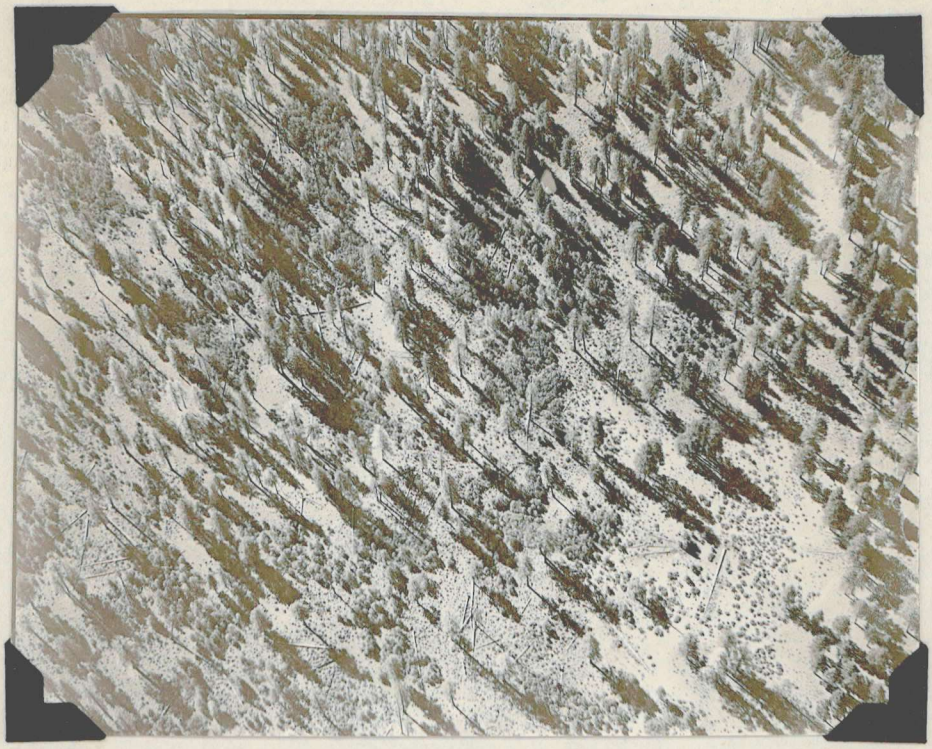


Airplane view of northeastern corner of Glass Mt. Unit. Beetle killed trees are scattered and constitute about 50% of the stand but are not conspicuously contrasted in the picture with green trees. Taken at an altitude of about 2000 ft. above forest. Sept. 25. 1927.

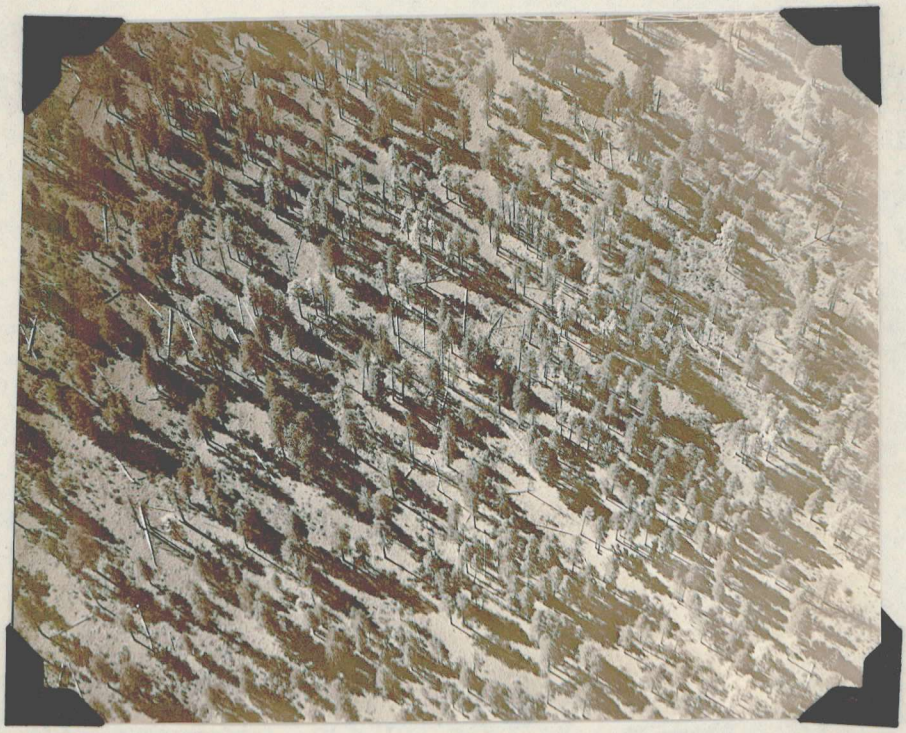


Airplane view (vertical) of Brown's Well Plot. Trees recently killed by beetles show white in the photograph. The white flag marked a corner of the plot and was made by arranging newspapers on the ground. Taken Sept. 28, 1927

Another vertical view of the Brown's Plot, covering an area of about 10 acres. Taken at an altitude of about 2000 feet above the forest. Sept. 28, 1927.



Vertical airplane view of Badger Well Plot, taken at an altitude of about 2000 feet above forest. Picture covers about 10 acres of ground surface and shows beetle killed trees as white tops. Sept. 28, 1927.



Another vertical view of the Badger Well Plot showing numerous beetle killed trees (white tops) taken at an altitude of about 2000 feet above the forest. Notice the sparse character of the stand. Sept. 28, 1927.

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
HENRY S. GRAVES, FORESTER

MODOC NATIONAL FOREST
CALIFORNIA
MT. DIABLO MERIDIAN
1920

Scale
1 ½ 0 1 2 3 4 5 Miles

NATIONAL FOREST BOUNDARY

MODOC NATIONAL FOREST
CALIFORNIA

HAPPY CAMP - LAVA BED AREA

Pine Beetle Loss For 1927

Legend.

Unit Boundaries: ———

Percent of Stand Killed in 1927:-

Less than 2%
Between 2% - 4%
" 4% - 6%
" 6% - 8%
" 8% - 10%
Over 10%

Nov. 1927

R. 14 E.
R. 15 E.
8th.
9th.
T. 40 S.
T. 41 S.
T. 48 N.
T. 47 N.
T. 46 N.
T. 45 N.
T. 44 N.
T. 43 N.
T. 42 N.
T. 41 N.
T. 40 N.
T. 39 N.
42°
50'
40'
30'
20'
Glass Mt. Unit
Timber Mt. Unit
Badger Unit
Happy Camp Unit.
White Horse Unit.
Pit River Unit.
Lava Unit
LAVA BED
BURNT LAVA BED
MODOC LAVA BED
Hoffman (G.S.)
Glass Mt. 7852
Timber Mt.
Double Head 5537
Mowitz Butte 5300 Adp.
Lone Pine Butte
Straw
Ice Cave
Dry Pond
Badger Spg.
Corral
Duncan House Camp
Deer Hill
Brown's Well
Lost Valley
Widow Valley
Log House
Bucher Swamp
Jaquina Reservoir
DEER HILL R.S.
Hog L.
Rail Mt.
Williams Reservoir
Spaulding Reservoir
Duncan Reservoir
Mud Lake
Mud Spg.
Lava Lake
Buck Butte
Crater
Round Mt.
Water Hole
Water Holes
LAVA R.S.
Sugar Pine Ridge
HAPPY CAMP R.S.
Grouse Spg.
Happy Camp Lookout
PIT RIVER R.S.
Casen Spg.
Canby
Scheffer Mt.
Standard
Crank Spg.
Egg Lake
Indian Spg.
Mayfield
Wiley Ranch
White Horse Valley
White Horse Res.
Payne Spg.
Large Spring
Little Hot Spring Valley
Day
Lookout
Widow Valley
Adin
Clear Creek
DUTCH FLAT R.S.
Steele Swamp
Pot Hole Valley
Pot Hole Spring
Bird Spg.
Quaking Asp Sp.
Willow Reservoir
Mowitz Reservoir
Surveyor's Valley
Lost River
Rock Cr.
Willow Cr.
Burner Cr.
Wasteway
Clear Lake Dam
Clear Lake Reservoir
Willow Springs
Mammoth CR.R.S.
Ranch
Steele Meadow
Four Mile Spg.
Warm Spg
F. Grabs
KLAMATH CO.
LAKE CO.
OREGON
CALIFORNIA
SISKIYOU CO.
MODOC CO.